Emir. J. Agric. Sci. 2000. 12:01-19

Effect of Naphthalene Acetic Acid, Calcium, Phosphorus, or Potassium on Fruit Quality, Abscission, and the Shelf Life of Guava Fruits.

K. M. Farag[1] and H. A. Kassem[2]

[1]United Arab Emirates Univ., Faculty of Agricultural Sciences, Dept. of Plant Production, Al-Ain 17555. UAE. E-mail: KarimF@uaeu.ac.ae.; [2]Alexandria University, Faculty of Agriculture, Pomology Dept., El-Shatby, Alexandria, Egypt.

ABSTRACT

Effect of different sources of phosphorus, potassium, or calcium alone or in combinations on 'Manshiya' clone guava was studied during two successive seasons 1995 and 1996. Naphtalene Acetic Acid (NAA) applications either alone or in combination with the three mentioned minerals were also investigated. At harvest, the data indicated that $CaCl_2$ treatment did not result in a significant increase in fruit weight in both seasons. However, the combination of $CaCl_2$ plus each of potassium phosphate, calcium phosphate, or NAA caused a significant increase in fruit weight as compared with the control. Similarly, the combination of NAA plus either potassium phosphate, or calcium phosphate, or $CaCl_2$ led to a significant increase in fruit weight as compared with the control in both seasons. Fruit firmness at harvest was significantly increased by $CaCl_2$ alone or in combination with NAA during both seasons while calcium phosphate was not effective in increasing flesh firmness either alone or plus NAA or potassium phosphate when compared with the control. Moreover, NAA alone was not able to significantly affect fruit firmness at harvest in both seasons. Fruit abscission was significantly reduced by potassium phosphate plus either NAA or $CaCl_2$ when compared with NAA or $CaCl_2$ alone in both seasons. Calcium phosphate was significantly more effective than $CaCl_2$ in reducing fruit abscission in both seasons. Carotenes in the fruit skin at harvest were not significantly increased by phosphorus sources such as potassium phosphate spray in both seasons as compared with the control. The addition of calcium phosphate to potassium phosphate did not result in a significant increase in carotene contents at harvest. After the shelf life period, NAA alone was not able to retard the loss of fruit firmness when compared with the control. However, the combination of NAA plus $CaCl_2$ caused a significant retardation in the loss of firmness in both seasons. Calcium chloride in addition to either calcium phosphate or potassium phosphate resulted in higher fruit firmness after 7 days on the shelf as compared with the control. It could be concluded that the combination of potassium phosphate plus NAA had positive effects on fruit quality and reduction of fruit abscission at harvest. Phosphorus sources, however, such as potassium phosphate were not effective in increasing carotenes at harvest even when combined with NAA or calcium phosphate.

Key Words: Nutrients, Foliar application, Maturity, Senescence, Storage.

INTRODUCTION

Guava is a popular fruit for fresh consumption in many countries. The fruit could be also used for processing. These features, together with the ease of culture and high nutritional value especially vitamin C, mean that this fruit is important in the international trade as well as in domestic economics of most tropical and subtropical countries (Samson, 1986).

Firm, yellow, fully mature guavas are desired for harvest but they don't keep well and are usually transported rapidly to processing plants. Many attempts have been made to extend the shelf life of guava fruits at room temperature (Dhoot et al., 1984). Most studies, however, have focussed on postharvest treatments (Singh et al., 1981 and Tandon et al., 1984).

Guava growers are also concerned with enhancing yellow color development. Thus in Egypt, they add large amount of phosphorus fertilizer to soil believing that it hastens yellow coloration. The role of phosphorus in increasing carotene formation in some fruits has been reported (Tucker et al., 1995). Studies also indicated that mature fruits show greater color and texture changes after harvest than less mature fruits (Brown and Wills, 1983).

Guava fruits falling off the tree prior to harvest occurs frequently. Dropped fruits are often injured and become less valuable. Preharvest guava drop may force guava growers to harvest earlier than desired. NAA was effective in delaying drop of many fruits (Weaver, 1972). The importance of NAA increased after the removal of Alar from the market.

The objectives of this study were to improve fruit quality at harvest, reduce preharvest drop, and extend the shelf life of fruits by using the spray method of NAA alone or in the presence of calcium, potassium or phosphorus from different sources.

MATERIALS AND METHODS

This study was conducted during two successive seasons, 1995 and 1996. Trees of 'Manshiya' guava were eight years old, vegetatively propagated by grafting on guava seedlings. They were nearly uniform, healthy, and grown under standard cultural practices. The trees were grown in a sand-loamy soil at Al-Maamoura area near Alexandria, Egypt.

The trees were treated by spray using a hand sprayer to the point of run off. Two sprays of each treatment were done on Oct. 11 and 20 during the two mentioned seasons and harvested 15 days after the second spray. Treatments included: water (control); NAA at 10 ppm; calcium superphosphate (mentioned as calcium phosphate) at 1000 ppm of 15% commercial fertilizer after dissolving in water and filtration with the supernatant used for preparing the spray solution; calcium chloride at 1000 ppm; NAA (10 ppm) plus calcium phosphate (1000 ppm); NAA (10 ppm) plus calcium chloride (1000 ppm); calcium phosphate (1000 ppm) plus calcium chloride (1000 ppm); pure potassium dihydrogen orthophosphate (mentioned as potassium phosphate at 1000 ppm); potassium phosphate (1000 ppm) plus NAA (10 ppm); potassium phosphate (1000 ppm) plus calcium chloride (1000 ppm), and finally potassium phosphate (1000 ppm) plus calcium phosphate (1000 ppm). Tergitol-S-15, a nonionic surfactant, was used at 0.1%, v/v with all treatments as a wetting agent. At harvest, twenty fruits were randomly picked from each treated tree. The following measurements were taken at harvest from 10 of them: fruit weight (gm); fruit length and diameter using hand caliper (cm); fruit firmness using pressure tester (Lb/in^2); total soluble solids using hand refractometer (%); titratable acidity by titration against 0.1 N NaOH (A.O.A.C., 1984); vitamin C content of the flesh using the endophenol method (A.O.A.C., 1984); and chlorophylls a and b and carotenes in the skin using spectrophotometric measurements (Wintermans and Mots, 1965). The cumulative preharvest drop as a percentage of the total number of fruits on three labeled main branches on each tree was used to detect fruit abscission.

The other 10 fruits of each replicate from the above random sample were left at 21±2° C for 7 days to evaluate their shelf life. By the end of the seven days, the following parameters were taken: weight loss (%), flesh firmness (lb/in^2), total soluble solids, titratable acidity, vitamin C content, chlorophylls a and b and carotenes. All measurements were taken using the same mentioned procedures.

Four replicates were used with each treatment. One tree represented one replication in a completely randomized design. The least significant difference was used to compare the means. The SAS computer program (1982) was used to obtain ANOVA and LSD (at 0.05).

RESULTS AND DISCUSSION

The results indicated that potassium containing combinations such as potassium phosphate plus NAA or $CaCl_2$ resulted in a significant increase in fruit weight as compared with the control in both seasons. Moreover, calcium phosphate plus each of NAA and $CaCl_2$, led to a significant increase in fruit weight as compared with the control in both seasons. Furthermore, NAA in the presence of $CaCl_2$ caused a significant increase in fruit weight in both season when compared with the control. Potassium phosphate-treated fruits tended to have greater fruit weight especially in the second season. Calcium chloride spray alone was not able to increase fruit weight in both seasons.

Table 1a. Effect of NAA, calcium, phosphorus, or potassium from different sources alone or in formulations on some fruit quality characteristics and abscission of "Manshiya" guava during the 1995 season

Treatment	Fruit Weight (gm)	Fruit Length (cm)	Fruit Diameter (cm)	Fruit Firmness (lb/in^2)	Fruit Abscission (%)
H_2O	132.54	6.85	6.33	8.43	6.66
NAA	167.00	7.27	7.04	8.57	4.44
Ca. Phos	164.88	7.21	6.85	14.69	2.77
$CaCl_2$	143.92	6.62	6.78	16.30	5.55
NAA+Ca. Phos	170.47	7.37	6.48	9.29	2.77
NAA+$CaCl_2$	134.00	7.98	6.90	17.21	4.99
Ca Phos+$CaCl_2$	149.18	6.57	6.32	16.45	3.33
K . Phos	142.64	7.03	6.39	14.23	2.22
K.Phos+NAA	192.00	9.01	7.49	13.77	1.66
K.Phos+$CaCl_2$	189.82	7.36	7.02	17.11	2.77
K.Phos+Ca Phos	178.87	7.67	6.80	13.57	1.66
L. S. D (0.05)	50.00	0.72	0.50	7.3	1.90

Ca. Phos: Calcium phosphate; K Phos: potassium phosphate.

Table 1b. Effect of NAA, calcium, phosphorus, or potassium from different sources alone or in formulations on some fruit quality characteristics of "Manshiya" guava during the 1995 season

Treatment	TSS (%)	Acidity (%)	Vitamin C (mg/100 ml)	Chlorophyll a (mg/100 ml)	Chlorophyll b (mg/100 ml)	Carotenes (mg/100 ml)
H_2O	10.93	0.60	295	0.61	0.45	0.17
NAA	11.00	0.44	254	0.77	0.35	0.42
Ca. Phos	11.53	0.51	289	0.31	0.51	0.55
$CaCl_2$	11.67	0.46	316	0.29	0.22	0.50
NAA+Ca. Phos	11.33	0.43	297	0.47	0.25	0.18
NAA+$CaCl_2$	10.67	0.49	303	0.27	0.48	0.45
Ca. Phos+$CaCl_2$	11.20	0.47	295	0.17	0.14	0.59
K . Phos	11.93	0.51	305	0.47	0.16	0.14
K.Phos+NAA	11.50	0.55	292	0.51	0.17	0.16
K.Phos+$CaCl_2$	12.40	0.46	389	0.53	0.16	0.27
K.Phos+Ca. Phos	11.50	0.48	319	0.39	0.18	0.37
L. S. D (0.05)	1.05	0.15	NS	NS	0.26	0.29

Ca. Phos: Calcium phosphate; K.Phos: potassium phosphate. NS: not significant

When calcium chloride was added to calcium phosphate, no increase was found in fruit weight when compared with the control or calcium chloride alone (Tables 1a and 2a).

A similar trend of results was obtained for fruit length. Potassium phosphate plus each of NAA or calcium phosphate caused a significant increase in fruit length in both seasons as compared with the control. Calcium chloride alone or in the presence of calcium phosphate did not cause a significant change in fruit length consistently. Potassium phosphate alone increased fruit length significantly only in the second season. Furthermore, NAA plus $CaCl_2$ resulted in significantly higher fruit length than the control in both seasons (Tables 1a and 2a).

With regard to fruit diameter, NAA alone or plus calcium chloride resulted in greater fruit diameter than the control. Moreover, calcium phosphate caused a significant increase in fruit diameter in both seasons when compared with the control. Calcium chloride alone or plus calcium phosphate did not increase fruit diameter in both seasons.

Data of fruit firmness at harvest (Tables 1a and 2a) indicated that calcium chloride alone or in combination with NAA caused a significant increase in fruit firmness during both seasons. Calcium in the form of calcium phosphate, however, was not effective in increasing flesh firmness either alone or plus NAA or plus potassium phosphate. NAA alone also was not able to significantly affect fruit firmness at harvest in both seasons.

Data of fruit abscission at harvest (Tables 1a and 2a) showed that most treatments were effective in reducing this abscission in both seasons. Calcium phosphate was significantly more effective than $CaCl_2$ in reducing fruit abscission in both seasons. The addition of potassium phosphate to either NAA or $CaCl_2$ further reduced fruit abscission as compared with NAA or $CaCl_2$ alone in both seasons. However, fruit abscission with NAA plus calcium phosphate or NAA plus calcium chloride was not significantly higher than fruit abscission with calcium phosphate or $CaCl_2$ alone. When we compared the effect of calcium phosphate and potassium phosphate on fruit abscission, there was no significant difference between both treatments in the two seasons. Total soluble solids (TSS) values at harvest (Tables 1b and 2b) indicated that each of $CaCl_2$, NAA, calcium phosphate, or potassium phosphate was not effective in changing TSS.

Furthermore, there was no significant difference between the effect of either $CaCl_2$ or calcium phosphate on TSS. The addition of NAA to calcium phosphate did not result in significant difference in TSS when compared with calcium phosphate alone. In a similar manner, the addition of NAA to potassium phosphate resulted in similar TSS values to that obtained with potassium phosphate. These trends were consistent in both seasons.

With regard to fruit acidity at harvest, it was found that $CaCl_2$, calcium phosphate or potassium phosphate did not affect acidity as compared with the control in both seasons. NAA alone or in combination with other chemicals such as calcium phosphate, $CaCl_2$, or potassium phosphate had a similar effect on acidity in both seasons. Even the combination of potassium phosphate plus $CaCl_2$ did not significantly change fruit acidity at harvest in both seasons (Tables 1b and 2b).

As shown in Tables 1b and 2b the fruits contained relatively high amount of vitamin C. However, there was no significant difference between the control and each of NAA, calcium phosphate, calcium chloride, or potassium phosphate in both seasons. Furthermore, there was no significant difference between NAA and its combinations with calcium phosphate, $CaCl_2$ and potassium phosphate in both seasons. The addition of $CaCl_2$ to potassium phosphate did not result in any significant change in vitamin C in both seasons when compared with the control.

The data in Tables 1b and 2b also indicated that there was no significant difference in chlorophyll a between all treatments and the control in both seasons. However, calcium phosphate plus calcium chloride, potassium phosphate, and potassium phosphate plus calcium phosphate caused a significant reduction in chlorophyll b as compared with the control in both seasons. Moreover, NAA alone or in combination with either $CaCl_2$ or calcium phosphate did not result in significant change in chlorophyll b in both seasons.

Concerning carotenes in the skin, the data showed that potassium phosphate, as a source of phosphorus, did not result in a significant increase in carotenes in both seasons as compared with the control.

Table 2a. Effect of NAA, calcium, phosphorus, or potassium from different sources alone or in formulations on some fruit quality characteristics and abscission of "Manshiya" guava during the 1996 season

Treatment	Fruit Weight (gm)	Fruit Length (cm)	Fruit Diameter (cm)	Fruit Firmness (lb/in^2)	Fruit Abscission (%)
H_2O	105.12	6.29	5.90	14.48	7.22
NAA	165.37	7.44	7.28	9.35	5.55
Ca. Phos	150.63	7.12	6.69	18.76	3.33
$CaCl_2$	117.78	6.05	6.05	22.36	6.11
NAA+Ca. Phos	141.00	7.05	6.73	9.72	2.22
NAA+$CaCl_2$	190.00	8.37	7.70	25.51	5.55
Ca.Phos+$CaCl_2$	121.00	6.25	6.09	15.47	3.33
K . Phos	140.00	7.04	6.29	12.01	2.77
K.Phos+NAA	154.32	7.61	6.33	24.28	2.22
K.Phos+$CaCl_2$	164.78	6.93	6.65	11.18	2.77
K.Phos+Ca. Phos	178.87	7.69	6.63	13.82	1.66
L. S. D (0.05)	34.8	0.64	0.61	6.43	0.91

Ca. Phos: Calcium phosphate; K.Phos: potassium phosphate.

Table 2b. Effect of NAA, calcium, phosphorus, or potassium from different sources alone or in formulations on some fruit quality characteristics of "Manshiya" guava during the 1996 season

Treatment	TSS (%)	Acidity (%)	Vitamin C (mg/100 ml)	Chlorophyll a (mg/100 ml)	Chlorophyll b (mg/100 ml)	Carotenes (mg/100 ml)
H_2O	11.2	0.46	281	0.27	0.45	0.29
NAA	11.4	0.52	269	0.38	0.35	0.48
Ca. Phos	11.13	0.43	260	0.52	0.54	0.28
$CaCl_2$	11.33	0.45	248	0.39	0.33	0.33
NAA+Ca. Phos	11.60	0.43	251	0.36	0.34	0.50
NAA+$CaCl_2$	11.80	0.51	356	0.48	0.35	0.28
Ca. Phos+$CaCl_2$	10.67	0.36	215	0.30	0.12	0.39
K. Phos	12.17	0.49	285	0.36	0.20	0.53
K.Phos+NAA	11.20	0.45	233	0.30	0.36	0.31
K.Phos+$CaCl_2$	11.87	0.52	362	0.45	0.48	0.36
K.Phos+Ca. Phos	11.13	0.47	323	0.36	0.11	0.50
L. S. D (0.05)	1.24	0.10	NS	NS	0.24	NS

Ca. Phos: Calcium phosphate; K. Phos: potassium phosphate; NS: not significant.

The addition of either NAA, $CaCl_2$, or calcium phosphate to potassium phosphate did not cause any significant change in carotenes at harvest. However, the effect of calcium phosphate, as a spray application, was not consistent. For example, calcium phosphate alone or in combination with $CaCl_2$ led to a significant increase in carotenes in the first season only (Tables 1b and 2b).

With regard to postharvest changes after 7 days on the shelf (Tables 3 and 4), the data indicated that there was no significant change in weight loss when all treatments were compared with the control in both seasons. The only treatment that increased weight loss percentage was NAA during the first season. There was a trend of relatively higher weight loss with the combination of NAA plus calcium phosphate in both seasons. However, these values were not significantly higher than NAA or calcium phosphate alone (Tables 3 and 4). Furthermore, NAA, $CaCl_2$, or calcium phosphate-treated fruits did not vary significantly from their combination in weight loss in both seasons.

Fruit firmness after 7 days on the shelf indicated that $CaCl_2$ plus each of NAA, calcium phosphate , potassium phosphate resulted in a significant increase in firmness as compared with the control in both seasons. In addition $CaCl_2$ treatment alone resulted in higher fruit firmness than the control in the first season. Calcium phosphate, however, did not cause a significant change in firmness as compared with the control. Moreover, NAA alone or in the presence of calcium phosphate did not retard the loss of firmness in both seasons. The combination of $CaCl_2$ and potassium phosphate caused a significant increase in fruit firmness when compared with calcium phosphate in both seasons (Tables 3 and 4).

Total soluble solids contents after 7 days on the shelf changed with many treatments (Tables 3 and 4). There was a significant reduction in TSS caused by NAA plus either calcium chloride or calcium phosphate in both seasons compared with the control. Moreover, NAA alone or potassium phosphate plus calcium phosphate also caused a significant reduction in TSS by the end of the shelf life period compared with the control. When we compare TSS values for NAA alone or its combinations with other chemicals, it was found that the addition of potassium phosphate to NAA significantly resulted in higher TSS than NAA alone after 7 days on the shelf. This was the only combination of NAA that resulted in higher TSS than NAA alone in both seasons.

Tables 3 and 4 also showed that most acidity values were significantly lower than the control in both seasons after 7 days on the shelf during both seasons. The addition of NAA to potassium phosphate significantly lowered the acidity compared to NAA or the control. However, the addition of calcium chloride or calcium phosphate to potassium phosphate significantly increased fruit acidity after the shelf life period in both seasons as compared with the control. In a similar way, the acidity of calcium phosphate treated fruits was significantly lower than its combinations with potassium phosphate in both seasons. Furthermore, fruit acidity with NAA alone was much higher than its combination with potassium phosphate in both seasons (Tables 3 and 4).

The data in Tables 3 and 4 also indicated that there was a significant reduction in vitamin C content in both seasons after 7 days on the shelf by potassium phosphate, calcium phosphate plus $CaCl_2$, and potassium phosphate plus NAA as compared with the control. However, calcium sources such as calcium phosphate, $CaCl_2$, or their combination with NAA did not have a significant effect on vitamin C.

Values of chlorophyll a after 7 days on the shelf indicated that there was no significant change in both seasons by all treatments. Furthermore, chlorophyll a content was similar whether the fruit received a single treatment or a combination. However, chlorophyll b content in the skin was reduced by all treatments relative to the control after 7 days on the shelf except with calcium phosphate in the first season. In a similar way, there was no significant change in carotenes after 7 days on the shelf (Tables 3 and 4) by all treatments in both seasons except with the combination of potassium phosphate plus $CaCl_2$ in the first season.

This study provided evidence on the possibility of improving guava fruit quality and extending its shelf life using nutrient spray alone or in various combinations. Guava were found to be climacteric in their respiratory behavior (Akamine and Goo, 1979) which explains their short shelf life. Firm, yellow, fully mature fruits are selected for harvesting. Mature guavas have a short storage life (Wilson, 1980).

Table 3. Postharvest characteristics after 7 days on the shelf of 'Manshiya' guava as influenced by preharvest applications of NAA, Ca, phosphorus, or potassium from different sources alone or in formulations during the 1995 season

	Weight Loss (%)	Fruit Firmness	TSS (%)	Acidity (%)	Vitamin C (mg/100 ml)	Chlorophyll a (mg/100 ml)	Chlorophyll b (mg/100 ml)	Carotenes (mg/100 ml)
H_2O	4.08	2.38	11.00	0.45	258	0.47	0.36	0.32
NAA	7.47	2.60	7.33	0.44	254	0.26	0.21	0.38
Ca. Phos	3.85	2.80	10.00	0.23	251	0.36	0.27	0.49
$CaCl_2$	3.95	5.67	10.60	0.19	282	0.31	0.21	0.46
NAA+Ca. Phos	6.48	2.60	7.33	0.36	317	0.28	0.18	0.40
NAA+$CaCl_2$	3.99	4.18	6.00	0.38	272	0.30	0.16	0.30
Ca. Phos+$CaCl_2$	3.76	5.15	12.00	0.30	184	0.34	0.11	0.59
K. Phos	3.98	5.17	10.53	0.16	159	0.23	0.15	0.55
K. Phos+NAA	4.52	5.62	9.86	0.12	102	0.23	0.21	0.44
K. Phos+$CaCl_2$	3.06	5.10	9.66	0.17	140	0.38	0.17	0.65
K.Phos+Ca.Phos	3.49	5.22	6.80	0.42	253	0.34	0.13	0.53
L. S. D (0.05)	2.98	0.43	1.38	0.13	52	NS	0.12	0.29

Ca. Phos: Calcium phosphate; K. Phos: potassium phosphate; NS: not significant.

Table 4. Postharvest characteristics after 7 days on the shelf of 'Manshiya' guava as influenced by preharvest applications of NAA, Ca, phosphorus, or potassium from different sources alone or in formulations during the 1996 season

	Weight Loss (%)	Fruit Firmness	TSS (%)	Acidity (%)	Vitamin C (mg/100 ml)	Chlorophyll a (mg/100 ml)	Chlorophyll b (mg/100 ml)	Carotenes (mg/100 ml)
H_2O	3.97	3.17	11.00	0.45	242	0.41	0.24	0.37
NAA	3.94	2.54	9.00	0.30	290	0.28	0.22	0.41
Ca. Phos	4.02	2.95	6.66	0.15	226	0.28	0.18	0.39
$CaCl_2$	3.92	3.15	11.66	0.20	252	0.24	0.17	0.35
NAA+Ca. Phos	4.81	2.60	8.60	0.34	240	0.26	0.18	0.49
NAA+$CaCl_2$	3.20	5.60	5.86	0.26	237	0.31	0.20	0.42
Ca. Phos+$CaCl_2$	3.84	4.22	6.33	0.18	119	0.33	0.16	0.42
K. Phos	3.41	4.86	4.00	0.19	155	0.34	0.21	0.50
K.Phos+NAA	3.16	5.33	11.73	0.12	116	0.34	0.16	0.48
K.Phos+$CaCl_2$	3.85	6.13	15.90	0.23	218	0.32	0.22	0.50
K.Phos+Ca.Phos	4.64	5.18	10.00	0.33	208	0.26	0.18	0.68
L. S. D (0.05)	1.64	0.58	1.81	0.12	85	NS	NS	NS

Ca. Phos: Calcium phosphate; K. Phos: potassium phosphate; NS: not significant.

Singh et al., (1981) found that calcium nitrate as a source of calcium (0.5 to 2.0%) to guava caused a reduction in weight loss, respiration rate, and maintained the edible quality of guavas for more than 6 days on the shelf after harvest. Treatment with calcium nitrate at 10% was found to be the most beneficial in prolonging the storage life of guavas.

Calcium chloride was found to increase fruit firmness either alone or in combination with NAA. It has been reported that calcium maintains the tissue integrity while NAA delays the progress towards senescence (Thimann et al., 1980). Calcium was associated with increased storage life of guavas (Chandra et al., 1985).

The effect of potassium on increasing fruit weight and dimensions was reported for many fruits (Ryugo, 1988). This agrees with our results where potassium formulations caused a significant increase in fruit weight, length, and diameter. Pandey et al. (1988) found that potassium sulphate at 1% increased fruit weight, size, TSS, and sugars of Sardar guava at harvest.

The role of NAA in reducing preharvest abscission was reported for many fruit crops (Ryugo, 1988) which agrees with our finding. Further reduction of fruit abscission was obtained when potassium phosphate was combined with NAA. Singh et al. (1996) found that NAA at 600 ppm reduced fruit drop and increased yield of Lucknow guava.

Heavy applications of nitrogenous fertilizers to yellow fruits such as peach, apricots, or guava delay the degradation of chlorophyll and the onset of carotene synthesis (Ryugo, 1988). Thus, it is possible to postulate that accelerated carotene formation of guava after heavy soil application of phosphorus by some growers might be just due to reducing the uptake of nitrogen. This explanation agrees with our finding that phosphorus spray was not effective in increasing carotenes in the fruit at harvest.

The present study provided evidence about the possibility of using many potassium and calcium sources to improve fruit quality and reduce abscission of guavas. However, direct application of phosphorus sources to fruits did not show a consistent increase in carotenes in order to improve the yellowing of guavas.

REFERNCES

Akamine, E. K. and T. Goo. 1979. Respiration and ethylene production in fruits of species and cultivars of Psidium and species of Eugenia. J. Amer. Soc. Hortic. Sci. 104:632.

AOAC. 1984. Official Methods of Analysis. 14th ed. Association of Official Analytical Chemists. Washington, D. C.

Brown, B. I. and R. B. H. Wills. 1983. Postharvest changes in guava fruit of different maturity. Scientia Horticulturae. 19:237-243.

Chandra, A., R. Yamdagni, O. P. Gupta, and R. Jain. 1985. A study on mobilization of 45Ca in Guava during storage. Progressive Horticulture. 17:190-192.

Dhoot, L.R., U. T. Desai, and D. A. Rane. 1984. Studies on the shelf life of guava fruits with polythene packaging and chemical treatments. Journal of Maharashtra Agricultural Universities. 9: 185-188.

Pandey, D. K., R. A. Pathak, and R. K. Pathak. 1988. Studies on foliar application of nutrients and plant growth regulators in Sardar guava (Psidium guajava L.). I. Effect on yield and quality. Indian J. of Horticulture. 45:197-202.

Ryugo, K (Ed. Kay Ryugo).1988. Fruit Culture: Its Science and Art., Univ. of California, Davis. Johan Wiley & Sons. USA. Pp. 344.

Samson, J. A. 1986, Tropical Fruits. Second Edition. Longman Scientific and Technical, Longman Group. UK.

SAS Institute. 1982. SAS Users Guide and statistical procedures. SAS Inst. Gary, N.C.

Singh, B. P., H. K. Singh, and K. S. Chauban. 1981. Effect of postharvest calcium treatments on the storage life of guava fruits. Indian Journal of Agricultural Sciences. 51:44-47.

Singh, B. P., G. Singh, and A. K. Singh. 1996. Changes in postharvest quality of guava affected by preharvest application of crop regulators. Singapore Jouranl of Primary Industries. 24:1-9.

Tandon, D. K., P. G. Adulse, and S. K. Kalra. 1984. Effect of certain postharvest treatments on the shelf life of guava fruits. Indian Journal of Horticulture. 41:88-92.

Thimann, K. V., R. C. Adelman, and G. S. Roth. 1980. Senescence in plants. Ed. Thimann, K. V. CRC Press. pp. 276.

Tucker, D. P. H., A. K. Alva, L. K. Jackson, and T. A. Wheaton. 1995. Nutrition of Florida Citrus Trees. University of Florida, Cooperative Extension Service. SP 169. Institute of Food and Agricultural Services. PP 61.

Weaver, R. J. 1972. Plant Growth substances in Agriculture. W. H. Freeman and Company, USA.

Wilson, C. W. 1980. Guava: in Tropical and subtropical fruits: composition, properties and uses. Nagy, S. and Shaw, P. F. eds, AVI publishing. USA. pp. 279.

Wintermans, J. F. G. and D. E. Mots. 1965. Spectrophotometric characteristics of chlorophylls and their pheophytins in ethanol. Biochem. Biophys. Acta. 448-453.

تأثير نفثالين حمض الخليك، الكالسيوم، الفوسفور، أو البوتاسيوم على جودة ثمار الجوافة وتساقطها وطول حياتها على الارفف

كريم محمد فرج[1]، حسن قاسم[2]

[1]جامعة الإمارات العربية المتحدة، كلية العلوم الزراعية، قسم الإنتاج النباتي العين، الإمارات العربية المتحدة. E-mail: KarimF@uaeu.ac.ae.[2]جامعة الإسكندرية، كلية الزراعة بالشاطبي، قسم الفاكهة، الإسكندرية، جمهورية مصر العربية.

ملخص

تمت دراسة تأثير الفوسفور والبوتاسيوم والكالسيوم من مصادر مختلفة كل بمفرده أو في مخاليط على ثمار الجوافة من سلالة "منشيه" أثناء الموسمين المتتاليين 1995، 1996، كما تمت دراسة أثر المعاملة بنفثالين حمض الخليك وحدة أو في مخاليط مع كل من العناصر التي أشير إليها على جودة الثمار وتساقطها وطول حياتها على الأرفف. وقد وجد عند جمع الثمار أن المعاملة بكلوريد الكالسيوم لم ينتج عنها زيادة معنوية في وزن الثمار في كلا الموسمين. ومع ذلك فإن خليط كلوريد الكالسيوم مع كل من فوسفات البوتاسيوم أو فوسفات الكالسيوم أو نفثالين حمض الخليك أدى لزيادة معنوية في وزن الثمار عند مقارنتها مع الكنترول. وبطريقة مشابهة فإن خليط نفثالين حمض الخليك مع كل من فوسفات البوتاسيوم أو فوسفات الكالسيوم أو كلوريد الكالسيوم قد أدى لحدوث زيادة معنوية في وزن الثمار إذا ما قورنت بالكنترول في كلا الموسمين. أما صلابة لحم الثمار عند الجمع فقد زادت معنويا نتيجة المعاملة بكلوريد الكالسيوم بمفرده أو في خليط مع نفثالين حمض الخليك في كلا الموسمين بينما لم تكن فوسفات الكالسيوم فعالة في زيادة صلابة الثمار سواء بمفردها أو في خليط مع نفثالين حمض الخليك أو فوسفات البوتاسيوم عند المقارنة مع الكنترول. كما أن نفثالين حمض الخليك بمفرده لم يكن مؤثراً على صلابة الثمار عند الجمع في كلا الموسمين. بالنسبة لتساقط الثمار فقد قل بدرجة معنوية نتيجة المعاملة بفوسفات البوتاسيوم في وجود نفثالين حمض الخليك أو كلوريد الكالسيوم إذا ما قورن بالمعاملة بنفثالين حمض الخليك أو كلوريد

الكالسيوم كل بمفرده في كلا الموسمين. كما وجد أن فوسفات الكالسيوم كانت أكثر فعالية من كلوريد الكالسيوم في تقليل تساقط الثمار في كلا الموسمين. أما الكاروتينات في بشرة الثمار عند الجمع فلم تزد بشكل معنوي نتيجة الرش بمصادر الفوسفور المختلفة مثل فوسفات البوتاسيوم في كلا الموسمين عند مقارنتها مع الكنترول. كذلك فإن إضافة فوسفات الكالسيوم إلى فوسفات البوتاسيوم لم ينتج عنها أي زيادة معنوية في محتوى الكاروتينات بالثمار عند الجمع. أما عن صفات الثمار بعد تخزينها على الأرفف فقد وجد أن نفثالين حمض الخليك لم يكم قادراً على تأخير فقد صلابة لحم الثمار عند المقارنة مع الكنترول ومع ذلك فإن خليط نفثالين حمض الخليك مع كلوريد الكالسيوم أدى للحصول على تأخير معنوي في فقد صلابة لحم الثمار بعد التخزين على الأرفف في كلا الموسمين. وبالنسبة لخليط كلوريد الكالسيوم مع كل من فوسفات الكالسيوم أو فوسفات البوتاسيوم فقد أدى للحصول على صلابة أعلى للثمار بعد 7 أيام من حياة الثمار على الأرفف عند المقارنة مع الكنترول. ويمكن أن نستنتج من هذه الدراسة أن خليط فوسفات البوتاسيوم مع نفثالين حمض الخليك كان ذو تأثيرات إيجابية على جودة ثمار الجوافة وعلى تقليل تساقطها عند الجمع لكن مصادر الفوسفور المختلفة مثل فوسفات البوتاسيوم لم تكن مؤثرة في زيادة محتوى الثمار من الكاروتينات عند الجمع حتى عند الخلط مع نفثالين حمض الخليك أو فوسفات الكالسيوم.

كلمات مفتاحية: عناصر غذائية، معاملات ورقية، اكتمال النمو، الشيخوخة، التخزين.